Distribution Patterns and Qualitative Composition of the Centipede Fauna in Forestal Habitats of Mainland Greece

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ABSTRACT

A preliminary overview of the centipede communities inhabiting the main forestal ecosystems of mainland Greece is presented. The study is based on data collected during the last fifteen years. The literature records are thus included, after a critical evaluation from both faunistic and taxonomic point of view. 54 species are considered. The following forms of forest vegetation are considered: sclerophyllous forests (*Pistacia* spp., *Quercus coccifera*) and their stages of degradation, deciduous oakwoods (*Quercus* spp.), firwoods (*Abies cephalonica*) and beech-fir forests (*Fagus* spp., *Abies* sp. gr. *alba*). The centipede community of each formation is discussed from a faunistical, ecological and zoogeographical point of view.

RÉSUMÉ

Modalités de la répartition et composition spécifique de la faune des chilopodes des milieux forestiers de la Grèce continentale.

Ce travail présente un premier bilan des peuplements de chilopodes occupant les principaux écosystèmes forestiers de la Grèce continentale. L'étude est basée sur les données réunies durant ces quinze dernières années. Les données de la littérature accessibles sont revues de manière critique à la fois du point de vue faunistique et du point de vue taxinomique et incluses dans ce bilan. On a pris en considération les formations forestières suivantes : forêts sclérophylles (*Pistacia* spp., *Quercus coccifera*) et leurs stades de dégradation, forêts décidues de chênes (*Quercus* spp.), sapinières (*Abies cephalonica*) et hêtraies-sapinières (*Fagus* spp., *Abies* sp. gr. *alba*). Le peuplement de chilopodes de chaque formation est examiné du point de vue faunistique, écologique et zoogéographique.

INTRODUCTION

The main works published to date on the ecology of centipede communities in the Mediterranean region deals only with some South-European areas, such as Spain (SERRA, 1978; SERRA & ASCASO, 1990) and Italy (MINELLI & IOVANE, 1987; ZAPPAROLI, 1992). No data are available for North-African and East-Mediterranean countries. The aim of this paper is to give a first qualitative picture of the centipede communities in the main forest habitats of mainland Greece, in order to characterize these habitats and to allow for synecological comparisons over the Mediterranean area.

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MATERIAL AND METHODS

In the present study the territory of Greece is considered as it is politically constituted today; the Egean Islands and Crete are not analysed. The analysis is mainly based on data collected in the last fifteen years (ZAPPAROLI, 1994), but all available literature records, critically reviewed both from faunistic and taxonomic point of view, are also included. About 280 sites are considered, 87 of which are known in their main vegetation features. 54 species of centipedes are considered: i-e about the 85% of the species occurring in the studied area and 67% of the whole Greek centipede fauna.

The discussion follows an ideal ecological-altitudinal sequence, principally according to DEBAZAC & NAVROMMATIS (1971), from the Mediterranean belt up to the higher mountain areas. The following forms of forest vegetation, loosely named from their dominant plant species, are distinguished: sclerophyllous broadleaved forests with *Pistacia lentiscus*, *Quercus coccifera* and *Quercus ilex* and their stages of degradation; deciduous thermophilous and mesothermophilous oakwoods dominated by *Quercus* spp.; coniferous woods with *Abies cephalonica*; broadleaved woods with *Fagus* spp. and *Abies* sp. gr. *alba*. The centipede community of each vegetation type is discussed from the faunistical and zoogeographical point of view; both general and local features are pointed out; characteristic species are also tentatively suggested.

In Table 1 the species are listed according to their presence/absence in the four habitats considered; the altitudinal ranges are tentative; chorotypes have been established according to VIGNA *et al.* (1992). SS = evergreen sclerophyllous formations; QQ = thermophilous and mesothermophilous broadleaved woods dominated by *Quercus* spp.; AC = woods dominated by *Abies cephalonica*; FF = broadleaved woods dominated by *Fagus* spp. and *Abies* spp. gr. *alba*. Chorotypes as follows: cae = Centroasiatic-european, eur = European, seu = S-European, sie = Sibiric-european, med = Mediterranean, tem = Turanic-european-mediterranean, tum = Turanic-mediterranean, wmd = W-Mediterranean.

RESULTS

Evergreen mediterranean sclerophyllous forests

These forests are physionomically characterized mainly by evergreen shrubs of woods. The most important species are *Pistacia lentiscus*, *Juniperus phoenicea*, *Ceratonia siliqua,* in the thermorphilous sites, between 0-600 m a.s.l., *Quercus coccifera* and *Phillyrea media*, mostly in more inland sites up to 1000-1200 m, while *Q. ilex* occurs in relatively mesophilous sites, from the sea level up to 650-800 m. Open habitats, such as phrygana, mainly derived from human activities (fire, grazing, cutting) in the Mediterranean forest, are related to the sclerophyllous formations. These habitats are especially characterized by *Cistus* spp., *Phlomis* spp. and *Sarcopoterium spinosum*. Sclerophyllous forests occur especially in Peloponnese and in Thessaly, but are also present in Macedonia, in Central Greece and in Thrace.

The general features of the centipede communities in the sclerophyllous and related open habitats of the whole mainland Greece are mostly characterized by very common widespread Mediterranean species such as *Scolopendra cingulata* and *Scutigera coleoptrata*, both invasive, the E-Mediterranean *Pleurolithobius patriarchalis*, and the S-European *Eupolybothrus litoralis*. Besides, *Bothriogaster signata*, widespread from Turan to E-Mediterranean steppes, *Himantarium gabrielis*, Mediterranean, and *Stigmatogaster gracilis*, S-European, inhabits especially open habitats. However, all these species are euriecious and occur also in disturbed or thermophilous broadleaved oakwoods and firwoods, up to 2000-2100 m a.s.l.

In the sclerophyllous formations of W-Greece, the above mentioned species are locally accompanied by the E-Mediterranean *Henia hirsuta*, *Nannophilus ariadnae*, *Scolopendra dalmatica* and the S-European *Lithobius hauseri*, all ranging between 0 and 900 m a.s.l. *H. hirsuta* is endemic to Epirus; *N. ariadnae* is recorded from Kerkira, Crete and Karpathos; *S. dalmatica* ranges from Greece to Istria along the Adriatic Sea coasts; *L. hauseri* is only known from Kerkira. In the phrygana of the Ionian Islands *Cryptops trisulcatus* is also present, mainly in thermophilous habitats of W-Mediterranean regions. Otherwise, this species has been recorded in Greece only from the S-Sporades, no mainland records are to date known and it is possible that the Ionian and Egean populations both result from introductions. In evergreen formations of W- and S-Greece the Mediterranean *Dignathodon microcephalum* and *H. bicarinata* have also been recorded. In E-Greece, characteristic Lithobiids occuring in sclerophyllous open habitats of Attica and W-Peloponnese are *L. carinatus*, widespread from Palestine to Greece, and *L. nigripalpis*, SE-European.

TABLE 1. — Centipedes from forestal habitats of mainland Greece (* = present, - = absent): species are grouped according to their ecological affinities. m = altitudinal range; C = chorotypes. Abbreviations & explanations in the text (Material & methods).

Species/habitats	SS	QQ	AC	FF	m	C
Stigmatogaster gracilis (Meinert)	*	-	-	-	0-500	seu
Dignathodon microcephalum (Lucas)	*	-	-	-	0->?	med
Henia bicarinata (Meinert)	*	-	-	-	0-1000	med
H. hirsuta Verhoeff	*	-	-	-	0-300	emd
Nannophilus ariadnae Attems	*	-	-	-	0-300	emd
Cryptops trisulcatus Brölemann	*	-	-	-	0-350	med
Scolopendra dalmatica C. L. Koch	*	-	-	-	0-900	emd
Lithobius carinatus L. Koch	*	-	-	-	0-800	emd
L. hauseri (Dobroruka)	*	-	-	-	0-500	seu
L. agilis C. Koch	*	*	-	-	200-1200	eur
Pleurolithobius patriarchalis (Berlese)	*	*	-	-	100-1100	emd
Bothriogaster signata (Kessler)	*	*	*	-	0-1700	tum
Henia devia C. L. Koch	*	*	*	-	0-1800	emd
Geophilus carpophagus Leach	*	-	-	-	50->?	eur
Pleurogeophilus mediterraneus (Meinert)	*	-	*	-	0-2100	seu
Scolopendra cingulata Latreille	*	*	*	-	0-2350	med
Scutigera coleoptrata (Linné)	*	-	*	-	0-1100	med
Eupolybothrus litoralis (L. Koch)	*	*	*	-	0-2200	seu
Lithobius brignolii (Matic)	*	-	*	-	800-1800	seu
L. microps Meinert	*	-	*	-	200-1700	seu
L. nigripalpis L. Koch	*	*	*	-	0-2500	seu
Pleurolithobius orientis (Chamberlin)	*	-	*	-	200-1100	emd
Lithobius muticus C. L. Koch	-	*	*	-	750-2200	ceu
Geophilus insculptus Attems	-	-	*	-	1900-2100	eur
Lithobius tenebrosus Meinert	-	-	*	-	1400-1500	eur
Geophilus linearis C. L. Koch	-	*	-	*	400-1900	eur
Lithobius crassipes L. Koch	-	*	*	*	600-1500	eur
L. latro Meinert	-	*	*	*	600-2000	seu
L. microps sensu AA.	-	*	*	*	300-1200	eur
L. peregrinus Latzel	-	*	*	*	800-1500	seu
Strigamia engadina (Verhoeff)	-	-	*	*	1100-2100	ceu
Cryptops anomalans Newport	-	-	*	*	500-2000	eur
Eupolybothrus transsylvanicus (Latzel)	-	-	*	*	700-1850	seu
E. werneri (Attems)	-	-	*	*	700-2300	sue
Lithobius lucifugus L. Koch	-	-	*	*	1200-2400	ceu
L. mutabilis L. Koch	-	-	*	*	1000-2000	ceu
L. schuleri Verhoeff	-	-	*	*	1200-2000	seu
Schendyla montana Attems	-	-	-	*	1200-1500	seu
Clinopodes trebevicensis (Verhoeff)	-	-	-	*	500-2200	seu
Strigamia transsilvanica (Verhoeff)	-	-	-	*	1150-1250	seu
Lithobius beschkovi Matic & Golemansky	-	-	-	*	1400	seu
L. lakatnicensis Verhoeff	-	-	-	*	1100	seu
Himantarium gabrielis (Linné)	*	*	*	*	0-1900	med
Henia athenarum Pocock	*	-	*	*	0-1300	emd
H. illyrica (Meinert)	?	*	*	*	0-2100	ceu
Clinopodes flavidus C. L. Koch	*	*	*	*	0-2400	cae
Pachymerium ferrugineum (C. L. Koch)	*	*	*	*	0-2300	tem
Cryptops hortensis Leach	*	*	*	*	200-1450	eur
C. parisi Brölemann	*	*	*	*	400-2400	eur
Eupolybothrus caesar (Verhoeff)	*	*	*	*	300-2100	seu
Harpolithobius anodus (Latzel)	*	-	*	*	0-2100	seu
Lithobius erythrocephalus C. L. Koch	*	*	*	*	150-2900	eur
L. lapidicola Meinert	*	*	*	*	100-2400	eur
L. viriatus Sseliwanoff	*	*	*	*	200-2400	seu
N° species (54)	33	23	36	29		

33 species altogether have been recorded from Greek sclerophyllous woodlands, and 9 of them seem to be exclusive of such habitats. The number of species in some *Q. coccifera* stands of Epirus, Macedonia and Central Greece (Ioannina, Amphitea; Kavala, Palea Kavala; Fthiotida, Purnari) range between 9-10. Under more thermophilous conditions, such as in *Pistacia lentiscus* shrubs or in phrygana, the number is much lower, with no more than 4-5 species (Evia, Nea Artaki).

Thermophilous and mesothermophilous broadleaved oakwoods

Greece oakwoods are mainly dominated by *Quercus pubescens*, *Q. cerris*, *Q. frainetto*, *Q. petrea*; other broadleaved species such as *Castanea sativa* and *Ostrya carpinifolia* may also be associated with. These formations are mainly distributed in Thrace, Thessaly and Macedonia, from low altitudes; the extend but marginally to Peloponese, where they are mainly restricted to the mountain areas.

The centipede communities of these woods are not easy to characterize: these habitats are heavily influenced by human activities which have affected both floristic composition and geographic distribution. Besides, faunistic and ecological data are still few. A large number of very euriecious species, widespread in European and in W-Paleartic regions, such as *Clinopodes flavidus*, *Pachymerium ferrugineum*, *Cryptops hortensis*, *Lithobius erythrocephalus*, *L. lapidicola*, has been recorded from Greek oakwoods. Species mostly common in the adjacent vegetation types, such as *Pleurolithobius patriarchalis* and *L. nigripalpis*, especially related to the sclerophyllous formations, or *Pleurogeophilus mediterraneus* and *L. brignolii,* more linked to the *Fagus* or *Abies cephalonica* woods, are also present. In oakwoods of Northern regions, we can find European or S-European species such as *Geophilus linearis*, *L. crassipes, L. peregrinus*, *L. microps* sensu auct., *L. viriatus*, also present in coniferous or in mesophilous broadleaved forests. In the mesothermophilous oakwoods sites of Epirus occur the S-European *Eupolybothrus caesar*, but it lives also in the beech-fir forest of the same area.

To date 23 species of centipedes have been recorded altogether from Greek oakwoods, but this value it is probably underestimated. No exclusive species are known. The number of centipede species recorded in some *Quercus* stands in N-Greece ranges from 6 (Kastoria, Gavros) to 9 (Garakas, Xanthi).

Coniferous woods dominated by Cephalonian fir and mesophilous decidous broadleaved woods dominated by beech and fir

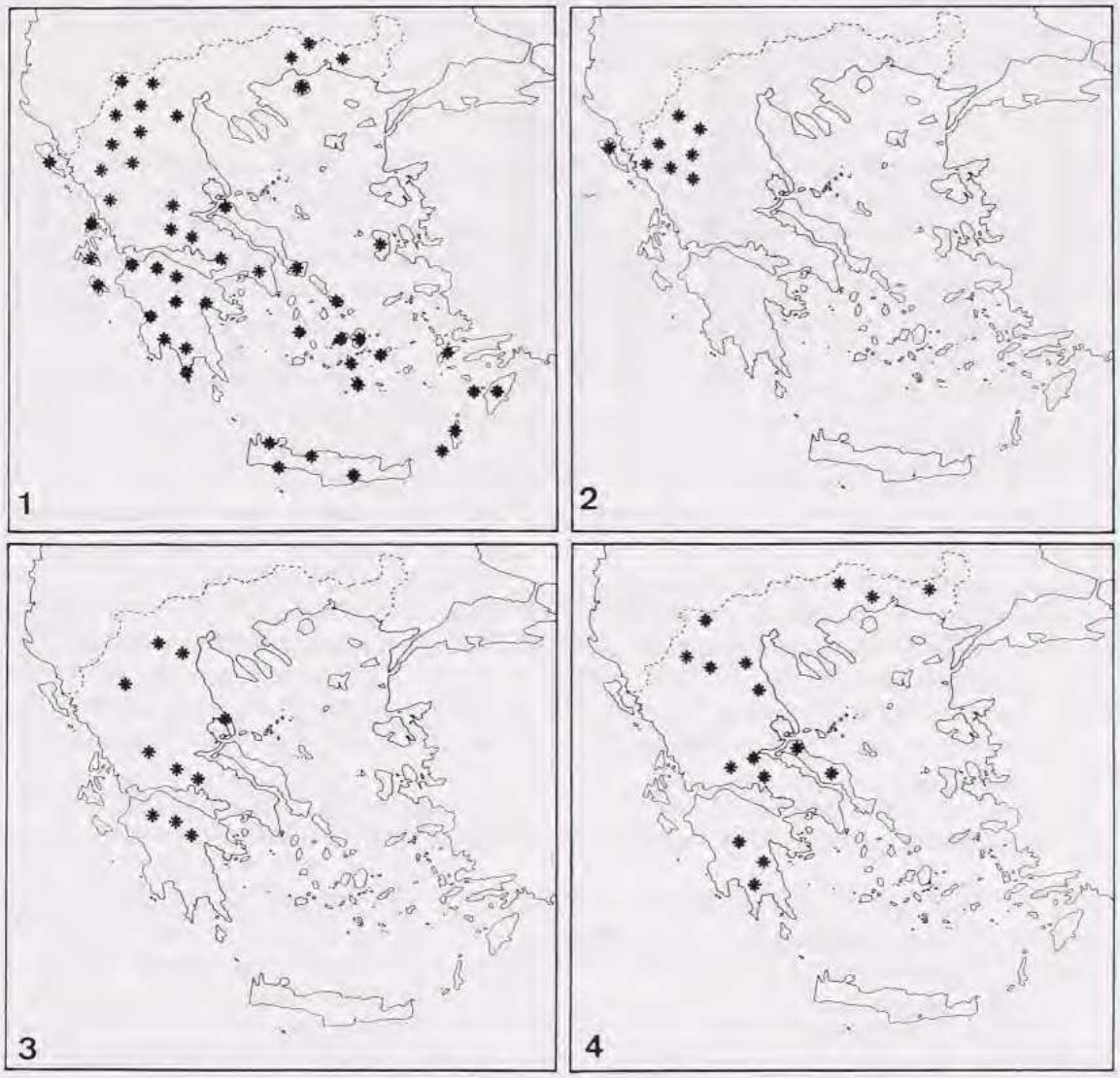
Owing to their relative faunistic homogeneity, the centipede communities of the two most important forestal habitats of mountain areas in Greece are discussed together.

Firwoods, dominated by the endemic *Abies cephalonica*, are characteristic of the Peloponnese, Attica and Central Greece, mainly between 550-2000 m a.s.l., according to the exposure. *Pinus nigra* is sometimes mixed with Cephalonian fir.

Fagus (*F. sylvatica*, *F. orientalis*) and *Abies* (*A.* spp. gr. *alba*) woods are mostly distributed in the Northern regions, along the Pindus, in E-Thessalia and N-Macedonian along the Mt. Rodopi. Beech and fir forests are also in Chalcidice and in Mt. Pangeo. Such formations generally begin from 850-1000 m a.s.l., but exceptionally (Chalcidice) they may be present from 200 m a.s.l. In these forests, the presence of the beech progressively increases from South to North, whereas that of *Abies* relatively decreases.

The main qualitative features of the centipede communities in Cephalonian firwoods and in beech-firwoods is largely similar. 42 species altogether have been recorded and about the 55% of these are recorded in both habitats. Many of the species recorded in such formations are widespread all over Europe, such as *Cryptops anomalans*, in Central Europe, or *Strigamia engadina*, *Lithobius lucifugus* and *L. mutabilis* or in SE-Europe, *Eupolybothrus werneri* and *L. schuleri*. The S-European *E. transsylvanicus* also inhabits *Fagus* woods as well Southernmost

A. cephalonica stands but Northern populations are morphologically distinguishable from Southernmost ones (Central Greece, Eubea, Peloponnese) (ZAPPAROLI, 1994). A relatively larger stock of Mediterranean species characterizes the *A. cephalonica* forests, up to 2000 m. In the Northernmost *Fagus* woods European especially S-European species, tend to predominate. However, Mediterranean species, such as *Himantarium gabrielis*, *Henia athenarum*, *Scolopendra cingulata*, are also present in Mt. Pangeo (Thracia) beechwoods, especially in the open and lowest sites of the Southern slopes.



FIGS 1-4. — Distribution of *Eupolybothrus* species in Greece : *E. litoralis* (1), *E. caesar* (2), *E. werneri* (3), *E. transsylvanicus* (4).

Lithobius tenebrosus, widespread in Europe, seems to be the main characteristic species under Cephalonian firwoods, ranging between 1100-2300 m. Five species seem to be characteristic of the beechwoods sites: *Schendyla montana*, *Clinopodes trebevicensis*, *Strigamia*

transsilvanica, *Lithobius lakatnicensis*, all distributed in S-Europe and up to date recorded in Greece only from Macedonia and Thracia, between 1100-1250 m a.s.l., and *L. beschkovi*, to date known from Macedonian. *L. lakatnicensis* is also known only from S-Bulgarian caves and closely related species are present in European Turkey. In N-Greece beechwoods it is also present *L. erythrocephalus borisi*, a race also known from SW-Bulgaria.

The number of species recorded in *Abies cephalonica* woods seems to be higher as compared to the other forestal types: 36 species have been sampled altogether but only one seems to be exclusive of this vegetation type. In Peloponnese (Mt. Killini, Mt. Taigetos) and in Central Greece (Mt. Parnasus) firwoods stands 13-17 species have been recorded. In Greek beechwoods, 29 species have been recorded altogether and 6 species seem to be exclusive. In some Macedonian *Fagus* woods (N-Pindus, Mt. Falakrö) 8-11 species have been recorded, whereas 10 species are at least present in Mt. Olimpos beechwoods and 18 species have been recorded in Katara Pass (Pindus) beechwoods.

CONCLUSION

Data on Chilopoda in forestal habitats of mainland Greece are still fragmentary and both qualitative and quantitative information is needed to reach adequate knowledge, especially of thermophilous and mesothermophilous oakwoods communities. Difficulties in drawing a complete picture also rise from the still incomplete faunistical and taxonomical knowledge of the Greek fauna. Besides, because of the heavy human impact that affects the S-Balkans forestal landscape, especiallay at the lower altitudinal sites, it is sometimes difficult to assess the original features of animal communities.

However, according to the preliminary data discussed in this contribution, the centipede communities inhabiting in the forestal habitat of Greece seem to show a qualitative composition characteristic and well related to the main bioclimatic and microclimatic conditions. Some indicators of different conditions could be recognized. Among Lithobiidae, the four Greek species of the S-European genus *Eupolybothrus* (Figs 1-4), well known both from taxonomic and faunistic point of view (ZAPPAROLI, 1994), could be tentatively used. According to their geographical distribution and habitat preferences, they can be listed according to a decreasing thermophilic sequence: *E. litoralis* present in a wide range of thermophilous habitats in mainland as well as in insular Greece from the sea level; *E. caesar* only inhabiting the thermophilous and mesothermophilous sites of Epirus from 300 m a.s.l.; *E. transsylvanicus* and *E. werneri* in mountain forestal habitats under *A. cephalonica* as well as *Fagus*, both from 700 m. The last three species do not occur in the Southernmost xerothermic areas such as Attika and Egean Islands.

The analysis of the chorotypes represented in the centipede fauna altogether recorded in each forestal habitat gives further useful informations to describe these communities (see Fig. 5).

The European s.l. species are the most important group in all forestal habitats of mainland Greece, their relative importance ranging from about 48% in sclerophyllous forest up to 90% in mesophilous *Fagus* woods. Species mainly ranging in S-Europe show, among the European s.l., the highest percentage in all habitats investigated and are dominant also in the more thermophilous biotopes (30%). The percentage of the Mediterranean s.l. species is high only in the mainland sclerophyllous forests (42%) whilst it is very low in the other forestal habitats (13% on an average). The E-Mediterranean group is the main among the Mediterranean s.l. species in sclerophyllous forests (24%). W-Palearctic species are poorly represented in all studied forestal habitats and they show similar percentages (9% on an average). A decrease of the percentage of the Mediterranean s.l. species accompanied by a progressive increase of the European s.l. species is clearly observed following the ecological sequence from the sclerophyllous ecosystems to the mesophilous beechwoods.

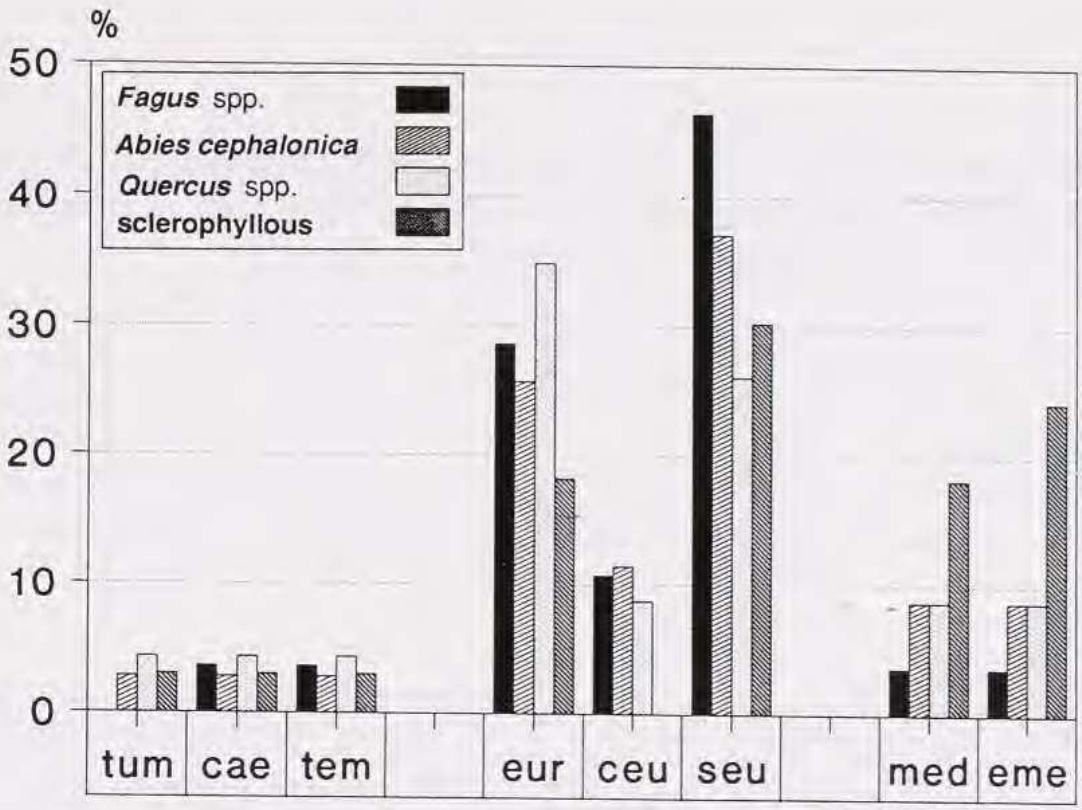


FIG. 5. — Chorotypes (%) represented in centipede communities of forestal habitats of mainland Greece. See Table 1 for abbreviations.

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